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ABSTRACT

A study, presented to the National Computer Conference, examined the existing methods of training highly competent and knowledgeable computer programers, analysts, and data processors. Four main sources of instruction were identified: (1) private electronic data processing (EDP) schools, (2) colleges, (3) manufacturers' schools, and (4) inhouse training within the industry. Each was considered inadequate. As a result, the people hiring (and firing) EDP staff were faced with an inadequate supply of well-qualified programers and analysts and an abundance of poorly-trained, unqualified, and inefficient personnel. This created an artificial limitation of the utility of industry computers. The study concluded that there is not one solution to the problem, which will continue in the field of business data processing. However, if sincere and conscientious steps are taken by the industry and educational institutes, the problem can be allieviated significantly. Industry stands to gain tremendously by working in partnership with colleges, universities, and private EDP schools for the of establishing guidelines and objectives for data-processing education. (WCM)

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EDP education—An acute crisis*

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INTRODUCTION

According to a recent AFIPS study,[1] the estimated number of unfilled openings for trained programmers in 1970 was between 200,000 and 650,000; and for systems analysts there were between 60,000 and 200,000 positions available. Industrial leaders are the first to admit that existing educational facilities are not adequate to supply the quantity and quality of training needed to fill the present market requirements—not to mention the steadily increasing demand foreseen for the future. From these observations it is obvious that the full potential of the computers presently in use cannot be realized because of the scarcity of sufficiently qualified programmers and analysts. As a consequence, many present-day computer installations are on the brink of chaos.

This shortage of sufficiently competent personnel hurts the computer users in more ways than just the imposition of artificial limitations on the utility of their computers. Since the demand exceeds the supply, job placement odds favor ill-qualified programmers and analysts. Such individuals change job after job, often landing better paying ones, and even more often compounding the miseries of their new-found employers.

The intent of the present paper is to examine the existing methods of training and to discuss the considerations involved in the development of educational programs for turning out highly competent and knowledgeable programmers, analysts, and data processors.

Without question, the most critical problems facing the people on the hiring (and firing) end of the EDP staff

- An inadequate supply of well-qualified programmers and analysts.
- An abundance of poorly trained, unqualified and inefficient personnel.

If the latter of the two observations seems unduly harsh, one need only consider the vast number of data processing installations that are approaching virtual collapse, caught months and years behind their schedules. A recent study by McKinsey & Company[2] of computers in 36 major firms states that "In terms of technical achievement, the computer revolution in U.S. business is outrunning expectations. In terms of economic payoff of new applications, it is rapidly losing momentum." It further states that ". . . from a profit standpoint, our findings indicate computer efforts in all but a few exceptional companies are in real, if often unacknowledged, trouble. Faster, costlier, more sophisticated hardware; larger and increasingly costly computer staffs; increasingly complex and ingenious applications: these are in evidence everywhere. Less and less in evidence, as these new applications proliferate, are profitable results. This is the familiar phenomenon of diminishing returns. . . ."

The March 25, 1970 issue of COMPUTERWORLD reported that McDonnel & Company, a 65-year-old securities dealer, will gradually liquidate its business. Reason: ". . . the failure of a new computer system to operate as it had planned, compounding the back office problems during the latter part of 1968 when stock brokerage volume was at a record level."[3]

Yet another example of mismanagement is contributed by the data processing department of the State of Massachusetts. According to a recent report filed by Donald R. Dwight, Commissioner of Administration, misuse and underuse have created a data processing wasteland, State legislators have charged, "mismanagement" of computer installations, and they plan to conduct public hearings on purchase procedures.[4] These are but a few of the many examples of doom brought on an organization by the data processors.

WHY SUCH A POOR SHOW?

Data processing, especially programming, has been and still is being taught as a trade. Most programming training is really an introduction to coding, and systems analysts are created by promoting senior programmers to new positions (rarely accompanied by any training in systems analysis). The educational institutions have also looked upon (or shall we say looked down upon) business data processing and analysis as technician's work, rather than an applied science. Little has been done to impart the discipline of a science to the data processing curriculum. The industry's record is no better. The recruiting, training, and treatment of EDP personnel have not been approached in the same manner, or with the degree of thoroughness, as is the case with engineers and scientific computing personnel. Very seldom does one

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hear about bridges collapsing, computers shorting out, or buildings tumbling. Even the leaning tower of Pisa is taking its sweet time. But there are scores of writeups on EDP project failures each month in EDP news magazines and papers. The lack of proper education and training in the field of business data processing is one of the major causes for the sad status of the data processing industry.

The computer is one of the most precise machines ever developed. And yet, little effort has been spent in imparting disciplined education to the people who use this machine as a tool for information processing and management. Training has been haphazard, and it continues to be so even today.

There are four main sources of instruction for data processing personnel: private EDP schools, colleges and universities, manufacturers' schools, and in-house training within the industry.

PRIVATE EDP SCHOOLS

Over the past decade approximately 1,000 private EDP schools have mushroomed into existence throughout the country. This has become a $100 million-a-year business. Individual schools charge as much as $2,000 for a six- to eight-month course. Often the performance records of these schools leave much to be desired. Most of the EDP schools are franchised, and unfortunately the franchise is usually bought by a salesman or commercially oriented person who wants to make a fast buck and disappear from the picture. These schools give their students very little other than a framable piece of paper. Very seldom is the franchise owner a person dedicated to, or even interested in, the cause of decent education. The quality of education provided by most of these installations is substandard, and their overall training approach provides little preparation for the actual business environment for which the student is being prepared.

The past few years have seen an increasing number of instances where the malpractices of such schools have been brought to the attention of public authorities. During an interview the director of the Massachusetts Consumer Protection Division remarked, "I will close every computer school in the state, if necessary. . . " to stop misrepresentation and fraud.[4] Fraud and malpractice have also been brought to the attention of the authorities in Texas, California, and many other states. Certainly there are reputable EDP schools imparting good educations, but their number is small.

Private EDP schools try to teach too much too fast to students who are simply not qualified. Most of these schools cover FORTRAN, COBOL, RPG, and assembler language in a six- to eight-month period, and some even throw in a course in PL/1 for good measure. All this is directed at students who have passed a watered-down, so-called aptitude test. Personal interviews with students from different schools on the West Coast revealed that most had not received any classroom exposure to tape and disk file processing. The main emphasis is on theory, and very little is placed on the practical side of business data processing expertise. These students get precious little experience in structuring problems for solutions and almost no exposure to information processing applications.

The instructors in these schools are usually underpaid, they are seldom qualified, and only rarely are they competent teachers. Instruction usually concentrates on the mechanics of the given languages, with very little time or effort being devoted to the overall logic of the language, its application, and basic programming techniques.

CONTROL OVER PRIVATE EDP SCHOOLS

Private EDP schools are on the front line in the effort to meet the needs of the manpower market for entry-level personnel in the coming years. These schools merit careful and continuous evaluation and guidance. Until recently, industry as a whole has chosen to disregard these schools; thus their effect on the quality of the education offered has been minimal. The participation of industry is essential to the proper orientation, control, and effective monitoring of these institutions. Industry should press for tighter governmental controls over the licensing and operation of such schools. Through its professional organizations, industry should draw up workable and practical standards for private schools, and such standards should be made available to the public, the press, and—most important of all—to the vocational counselors.

Recent EDP school guidelines prepared independently by the ACM and DPMA represent a major step toward the standardization of educational benchmarks and goals. However, such organizations cannot by themselves legislate a workable solution, nor can they force individual schools into compliance. One obvious practical solution lies in industry's backing up its evaluations by providing legitimate employment opportunities to graduates of the schools that uphold high academic and professional standards. Furthermore, the data processing industry, as potential employers, should realistically evaluate their existing and future job requirements for trainee-level personnel. This should be conveyed clearly to reputable EDP schools.

WHAT ABOUT COLLEGES?

One of the greatest enigmas is the gross failure of colleges and universities to involve themselves in the development of business data processing science. The academicians are among the worst culprits in the unforgivable practice of imparting substandard and superficial instruction and representing it to be far more than it is. Only a handful of universities and four-year colleges are presently offering programs leading to degrees in business data processing, and very few have plans to implement such programs. Why have the pundits of higher education chosen to ignore such a vital field? Very few institutions offer courses in data processing systems design, data structures, information retrieval, analysis methods, programming techniques and applications, mathematics oriented to business data processing, and other related subjects. Usually the courses are aimed at engineering

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and scientific uses of the computer. The emphasis is on pure science, with only cursory attention paid to the development of applied computer techniques for commercial utilization.

One reason for the poor quality of courses and the inadequacy of instruction stems from the manner in which the faculty at such institutes gets its exposure to business data processing. One or two instructors (in the fields of management, law, accounting, marketing, etc.) leaf through this or that manual for a given language, write a few elementary programs, and—without further ado—a data processing professor emerges. They usually have only skeletal knowledge of the language and often no appreciation of the real world of data processing. Engineering, mathematics, or even basket-weaving departments would never allow so shoddy an arrangement. Nonetheless, these people are now acknowledged leaders in the academic world of data processing. Just because a person happens to have the title of assistant, associate, or full professor in law, marketing, management, or accounting, it does not mean that the same person, by reading a few manuals, has qualified himself as a professor of data processing. It is not uncommon to assign such teachers to data processing classes for the sole purpose of filling their minimum unit load requirements. These instructors are usually only about a semester ahead of their students. What a flagrant violation of a student's basic rights to decent education. This is not to suggest that they are incapable of teaching such courses, only that they should be required to get vigorous training and first-hand experience before taking up teaching assignments.

The educational community has failed to realize the importance of disciplined training in business data processing. Proof of this is the lack of adequate—much less excellent—courses in colleges and universities throughout the country.

The California State Universities and State Colleges have acquired a network of third-generation computers with a price tag of approximately $8,000,000. Nonetheless, only one of these schools, California Polytechnic State University at Pomona, provides a major in business data processing—and only at the undergraduate level. Of the other schools in the system, only California Polytechnic State University at San Luis Obispo offers a substantial number of courses in business data processing. The University of California, Kansas State University, Howard University, Georgia Institute of Technology, Ohio State University, and Brigham Young University are typical of a seemingly endless list of excellent schools that, while offering instruction in computer sciences, have not seen fit to offer many courses in business data processing.

In his keynote address to the ACM Conference on Personnel Research, Anthony Oettinger of Harvard stated, "We ought to help the programmer survive by proper education. But who can we look to for such education? Not the new departments of computer science in universities. These departments are just getting out from under the influence of competing engineering and mathematics departments, and they are too busy teaching Simon-pure courses in their struggle for academic recognition to pay serious time and attention to the applied work necessary to educate programmers and analysts for the real world." The degree of purity of the computer science that is taught," claimed Oettinger, "is inversely related to the competence of the department in meeting social needs." He further stated, "We don't need any courses in Latin to develop general powers of reasoning. . . ."[4]

INDUSTRY AND THE COLLEGES

In the long run, colleges and universities are the only hope for well-qualified business data processing professionals. The data processing community should exert pressure on the academicians for the rapid implementation of new courses and the upgrading of the existing ones. The business community can show its real interest by setting up scholarships and by contributing time, expertise, financial assistance, excess computer time, and whatever else might be available to help establish a business data processing curriculum and adequate facilities in colleges. The educators need this type of participation rather than donations of obsolete hardware that give the donors handsome tax writeoffs and the recipients perpetual headaches.

Colleges, on the other hand, should abandon their ivory towers as far as education in business data processing is concerned. They should seek advice and help from the industry in designing data processing courses. The academic community should not feel that asking for guidance in such matters from the people in the industry is belittling. The commercially oriented people are the ones who are faced with the problems. They know what basic knowledge and training is required. They know what general trends exist in the industry and what will be needed in the foreseeable future.

One reason for the shortcomings of business data processing courses in colleges and universities is the dearth of qualified faculty. To fill this void, serious consideration should be given to the possibility of employing knowledgeable people from the industry. These people may not fulfill the established degree and credential requirements, but they have much more to offer the student than a professor with a degree in accounting or law and a short course in a computer language. "A little knowledge is a dangerous thing."

The programs offered by colleges and universities should concentrate on business data processing systems design, analysis methods, programming logic and techniques, business mathematics, data structures and information retrieval, equipment evaluation and selection, and the design, evaluation, and implementation of software. Refresher courses for upgrading industrial staff members already working with the computer should not be neglected. Courses oriented to the problems of data processing management and executive education should be offered through seminars and workshops. If business data processing applications are to attain the same stature as other applied sciences, they will have to be accomplished in an environment conducive to such development, and they will require some formidable exertion on the part of educators.

Industry, on the other hand, should offer programs in

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which teachers from colleges can be given opportunities to obtain first-hand experience in practical data processing. This could be realized in the following ways:

- In-house training programs during summer or at other convenient periods to train the sort of data processing teachers the industry particularly requires. The businesses that are most influential in the future of EDP should take the initiative in this matter and establish lines of communication with various colleges and universities.
- Occasional workshops in the advanced "state-of-the-art" could be offered for teachers to keep them informed about the latest innovations and developments within the industry.
- Some larger commercial installations might see their way clear to lending various sorts of assistance to prepare students of selected colleges for the real world of computer applications.

The long-range benefits from such programs will outweigh by far the immediate expenditures incurred by the computer industry.

COMPUTER MANUFACTURER SCHOOLS

Objectively speaking, the training imparted by the computer manufacturers does not deserve many laurels, either. Nonetheless, the level and extent of such training has, in many ways, saved the business data processing industry from total disaster. Their efforts in developing qualified user personnel for their equipment have at least supplied the industry with a large number of coders and some programmers and analysts. However, the training provided by the manufacturer schools should be recognized for what it is: training in how to make *their* computer execute procedures. The emphasis is merely on teaching people the instruction set of a given language. Little or no emphasis is placed on basic programming logic, file structure, file organization, system analysis techniques, system design methods, efficiency considerations, and documentation methods. People so narrowly trained end up learning only the language instruction sets. They certainly are not taught to program well, since very little emphasis is put on the logic and structure of the computer language, even though logic is the backbone of good programming. Some of the computer manufacturers have been providing essentially a makeshift education in EDP—yielding quick, generally flimsy, results.

IN-HOUSE TRAINING: A FIRST SOLUTION

It is easy to call for upgrading of private EDP schools and the institution of new and better courses at colleges and universities. However, it would be a long time before such efforts would really start to pay off. For example, it takes many years before new courses can be taken from conceptual stages to full implementation. Then, there is the need for upgrading the programmers and analysts who, due to a lack of real education, are contributing to the delinquency of the data processing industry.

The internal turmoil, inefficiency, and overall confusion within the majority of data processing installations stems from the quality and extent of training given to in-house programmers and analysts. Top management has been led to believe that programmer training is a fairly straightforward and not-so-important matter. The usual sequence of steps for in-house selection and training of programmers[7] goes like this:

- Administering an aptitude test to a number of company employees.
- Selecting a group of people who happen to have done well on the above tests and who can be spared from their present jobs.
- Having them attend a two- to three-week class conducted by the computer manufacturer.
- Placing them in the data processing department to start programming.

This approach to programmer training is in many ways similar to preparing "instant potatoes". What you get is a substandard product; in fact, you have created the "instant programmer".[8] The entire approach is open to serious challenge.

Quickie training of this sort exposes the student to nothing more than how to code—not even how to code well. The main emphasis is on programming languages, and during the training phase an average student will write one or two elementary programs. Basic EDP concepts are completely overlooked, and the results are disastrous.

The first step in improving the performance of the data processing departments is to improve the in-house training methods. The categories listed below provide a frame of reference for identifying programmer training needs:

- Basic familiarity with computer hardware and general architectural concepts.
- Introduction to programming, the bases of systems analysis, operating systems, and software.
- Learning the structure, usage, logic, and application of the programming language.
- Introduction to good programming habits, documentation, program optimization, and program structuring methods.
- On-the-job training in programming application—starting with simple I/O oriented programs—to be reinforced with discussions on modular programming concepts, desk-checking, and debugging techniques.
- Periodic seminars, workshops, or discussion group meetings to explore such subjects as file organization and resources, decision table application, and other related subjects.
- Occasional discussions on the efficient usage of company software, various utility routines, and job control language.

It is realized that it may not be possible for many installations to institute a formal training program, and in other cases it may not be advantageous to go deeply into every

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suggested area of study. Reasons for this could be many: lack of funds, very small staff, lack of training material and personnel. However, most installations will need to develop some type of organized approach if they are to survive the increasing shortage of well-qualified data processors.

The question arises: How can an organization develop adequate, workable, in-house programmer training material? The points outlined below, with certain modifications and adjustments, may be the solution for many companies:

- Conducting formal classes in those areas that tend to be formalized and routine, e.g., programming languages, introductions to hardware and software. The scope of each class will depend mostly on the background and needs of the participants. The overall approach and organization of such classes should be flexible enough to accommodate participants with varying degrees of experience. Such classes could be supplemented by programmed instruction (PI) and audiovisual courses available from computer manufacturers and other EDP educational concerns.
- Holding informal one- or two-hour workshops once a month may be advisable for dealing with topics of limited relevance to the majority of data processing employees, e.g., sessions on program debugging, uses of certain utility routines, interpretation of dumps, etc.
- Company management should also explore the possibility of inviting experts from other companies, reputable computer consultants, and qualified teachers from local colleges to discuss such matters as data structures and information retrieval, file organization techniques, and design and handling of large computer projects.
- An excellent method to fire up individual interest is to set aside a one-hour meeting time, perhaps once every three months. Different subjects are selected by the participants, and each month a programmer prepares and conducts the meeting on one subject, followed by a question-and-answer period. It is surprising how much good material can be developed through such meetings and, at the same time it gives the participants a sense of accomplishment.

Similar training methods and approaches can be applied to the upgrading of the systems analysis staff. The following categories identify the training needs in general:

- Basic training in the use of existing hardware and software. It is very important that a systems analyst have a clear understanding of the capabilities as well as limitations of the company hardware and software. New systems analysts, especially the entry-level personnel, should be familiarized with basic data processing and computer concepts, computer programming, and the software in use.
- Training in analysis and system design. This phase of training may touch on such topics as feasibility studies, basic system design, system development, and system implementation fundamentals.
- The system staff should be kept cognizant of all software changes, i.e., changes in operating environment, new utilities, new procedures, etc.
- Professional development. This phase of training involves those areas of systems development that will help the analyst to develop better and more efficient systems. Specifics of this area of training could be: the use of decision tables, special system techniques applicable to problems at hand, training in various phases of company business, test data generation, and system testing techniques.
- Other short courses such as effective communication, effective writing, leadership, problem analysis, financial management and budgeting, and interpersonal effectiveness should also be looked into.

In-house training requires considerable thought, planning, and commitment by the top executives, time and effort by the data processing staff, and inevitably, a definite financial outlay. However, such efforts will pay big dividends: more efficient use of company hardware and software, better employee morale, and above all, a smoothly operating data processing department—to name just a few.

CONCLUSION

There is no one solution to the problems that exist, and will continue to exist, in the field of business data processing. However, if sincere and conscientious steps are taken by the industry and the educational institutes, the problems could be alleviated significantly. It is obvious that the industry stands to gain tremendously by working in partnership with colleges, universities, and private EDP schools for the purpose of establishing sorely needed guidelines and objectives.

The collapse of McDonnel & Co.,[3] chaos in the data processing department of the state of Massachusetts,[4] and the general confusion and mismanagement that abounds should serve as dire warning to industry of the great peril at its gates. Industry is limping along hoping that manufacturer's schools, colleges, universities, and private EDP schools will improve their education and training systems, and the education institutes are expecting the same of the industry. But problems will never be solved unless all parties come together and agree on a system of data processing education that is mutually beneficial to the educators, the potential students, and the industry as a whole.

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